What is claimed is:

[Claim 1]

1. A process of coating an article having a wall region defining an external surface on an exterior of the article and an oppositely-disposed internal surface within the article, the process comprising the steps of:

forming diffusion coatings on the internal and external surfaces of the article, the diffusion coating on the external surface comprising an additive layer and a diffusion zone that is beneath the additive layer and extends into the wall region;

removing the additive layer and at least a portion of the diffusion zone of the diffusion coating on the external surface of the article so as to define an exposed surface region on the exterior of the article; and then

depositing an overlay coating on the exposed surface region;

wherein the portion of the diffusion zone removed is sufficient to inhibit formation of a secondary reaction zone in the exposed surface region.

[Claim 2] 2. The process according to claim 1, wherein the diffusion coatings are simultaneously formed on the internal and external surfaces of the article.

[Claim 3] 3. The process according to claim 1, wherein the diffusion coatings are diffusion aluminide coatings.

[Claim 4] 4. The process according to claim 3, wherein substantially all of the diffusion zone is removed during the removing step.

[Claim 5] 5. The process according to claim 1, wherein the overlay coating consists essentially of intermetallic phases.

[Claim 6] 6. The process according to claim 5, wherein the overlay coating consists essentially of beta-phase NiAl intermetallic containing, in atomic percent, about 30% to about 60% aluminum, optionally up to about 10% chromium, 0.1% to about 1.2% of at least one element chosen from the group consisting of zirconium, hafnium, silicon, yttrium, and titanium, the balance being essentially nickel.

[Claim 7] 7. The process according to claim 1, wherein the overlay coating is an aluminum-containing bond coat, the process further comprising the step of depositing a ceramic coating on the bond coat.

[Claim 8] 8. The process according to claim 7, wherein the ceramic coating comprises yttria-stabilized zirconia.

[Claim 9] 9. The process according to claim 7, further comprising the step of depositing on the ceramic coating a coating layer that exhibits in comparison to the ceramic coating at least one property chosen from the group consisting of increased erosion resistance and increased resistance to infiltration of CMAS.

[Claim 10] 10. The process according to claim 7, further comprising the step of depositing on the ceramic coating a coating layer that has lower thermal conductivity than the ceramic coating.

[Claim 11] 11. The process according to claim 1, further comprising the step of depositing on at least the external surface a barrier layer prior to forming the diffusion coatings, the barrier layer

inhibiting interdiffusion between the diffusion coatings and the wall region.

[Claim 12] 12. The process according to claim 1, wherein the wall region is formed of an alloy containing at least one refractory metal selected from the group consisting of about 6.5 weight percent or more of tantalum, about 5 weight percent or more of tungsten, about 2 weight percent or more of molybdenum, and about 3 weight percent or more of rhenium.

[Claim 13] 13. The process according to claim 12, wherein the superalloy consists of, by weight, 0.4% to 6.5% ruthenium, 4.5% to 5.75% rhenium, 5.8% to 10.7% tantalum, 4.25% to 17.0% cobalt, up to 0.05% hafnium, up to 0.06% carbon, up to 0.01% boron, up to 0.02% yttrium, 0.9% to 2.0% molybdenum, 1.25% to 6.0% chromium, up to 1.0% niobium, 5.0% to 6.6% aluminum, up to 1.0% titanium, 3.0% to 7.5% tungsten, and wherein the sum of molybdenum plus chromium plus niobium is 2.15% to 9.0%, and wherein the sum of aluminum plus titanium plus tungsten is 8.0% to 15.1%, the balance nickel and incidental impurities.

[Claim 14] 14. The process according to claim 12, wherein the superalloy consists of, by weight, about 10 to about 15% cobalt, about 4.0 to about 6% chromium, about 0.5 to about 2.0% molybdenum, the combination of Cr+Mo from about 4.6 to about 6.5%, about 7 to less than 9.25% tantalum, about 5 to less than 6.25% aluminum, about 5 to about 6.5% tungsten, about 5.1 to about 5.6% rhenium, about 0.1 to about 0.5% hafnium, about 0.02 to about 0.07% carbon, about 0.003 to about 0.01% boron, up to about 0.03% yttrium, up to about 6% ruthenium, up to about 1% niobium, with the balance nickel and incidental impurities.

[Claim 15] 15. A process of coating an article having a wall region formed of an alloy that is susceptible to formation of a secondary reaction zone as a result of containing at least one refractory metal selected from the group consisting of about 6.5 weight percent or more of tantalum, about 5 weight percent or more of tungsten, about 2 weight percent or more of molybdenum, and about 3 weight percent or more of rhenium, the wall region defining an external surface on an exterior of the article and an oppositely-disposed internal surface within the article, the process comprising the steps of:

simultaneously forming diffusion aluminide coatings on the internal and external surfaces of the article, each of the diffusion aluminide coatings comprising an additive layer and a diffusion zone that is beneath the additive layer and extends into the wall region;

without removing the diffusion aluminide coating on the internal surface of the article, removing the additive layer and substantially all of the diffusion zone of the diffusion aluminide coating on the external surface of the article so as to define an exposed surface region on the exterior of the article; and then

depositing on the exposed surface region an overlay coating consisting essentially of beta-phase NiAl intermetallic;

wherein the portion of the diffusion zone removed is sufficient to inhibit formation of the secondary reaction zone in the exposed surface region.

[Claim 16] 16. The process according to claim 15, wherein the overlay coating consists of, in atomic percent, about 30% to about 60% aluminum, optionally up to about 10% chromium, 0.1% to about 1.2% of at least one element chosen from the group consisting of zirconium, hafnium, silicon, yttrium, and titanium, the balance nickel and incidental impurities.

[Claim 17] 17. The process according to claim 15, further comprising the step of depositing a ceramic coating on the overlay coating.

[Claim 18] 18. The process according to claim 16, wherein the ceramic coating comprises yttria-stabilized zirconia.

[Claim 19] 19. The process according to claim 16, further comprising the step of depositing on the ceramic coating a coating layer that exhibits in comparison to the ceramic coating at least one property chosen from the group consisting of increased erosion resistance, increased resistance to infiltration of CMAS, and lower thermal conductivity.

[Claim 20] 20. The process according to claim 15, further comprising the step of depositing on at least the external surface a barrier layer prior to forming the diffusion aluminide coatings, the barrier layer inhibiting interdiffusion between the diffusion aluminide coatings and the wall region.